

Blue Crab Parameter Error – UPDATE 1-21-2020

The Brylawski and Miller (2003) bioenergetics model for Blue Crab was not included in the suite of models included with Fish Bioenergetics 4. It was not initially clear why. Perhaps, this was because when the model parameters are added to FB4, model results do not match up with the curves in the paper. Apparently, there is a parameter error in this paper.

To parameterize FWM for LPR, both Windward and WPC independently added the published FB4 parameters to the FB4 input file and ran the model. However, examining the FB4 output against the curves in the paper illustrates the apparent error (Figure 1). Finally, a corrected parameter set was derived by changing the RQ parameter and the resulting model closely reproduces the data shown in the paper.

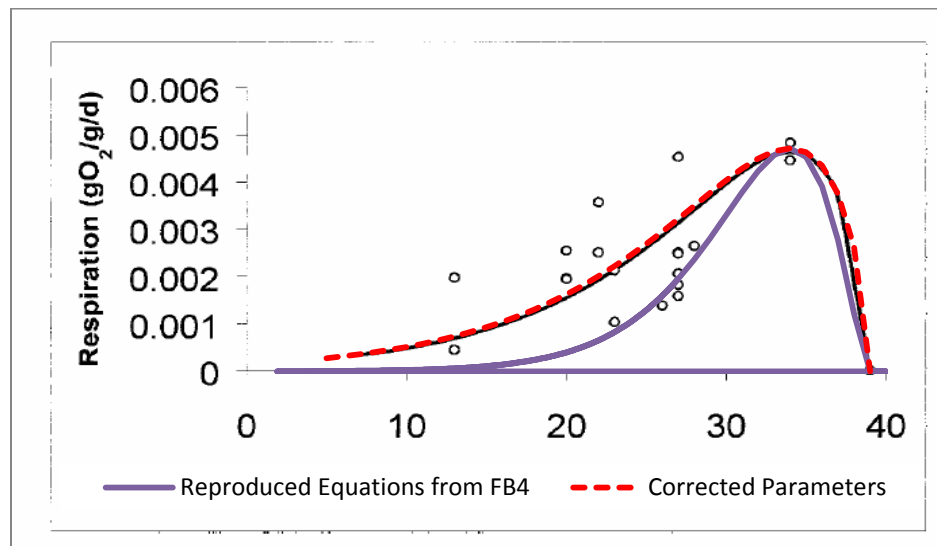


Figure 1. Figure 4 from Brylawski and Miller (black curve) with data (open circles) and derived curves plotted over the top to the same scale. Degrees centigrade are on the horizontal axis.

However, a comparison of Figure 3 and Figure 4 from Brylawski and Miller indicate that the data shown are for 1-g juvenile crabs (Figure 2). A more appropriate weight range for blue crabs observed in the LPRSA would be 140-170 g.

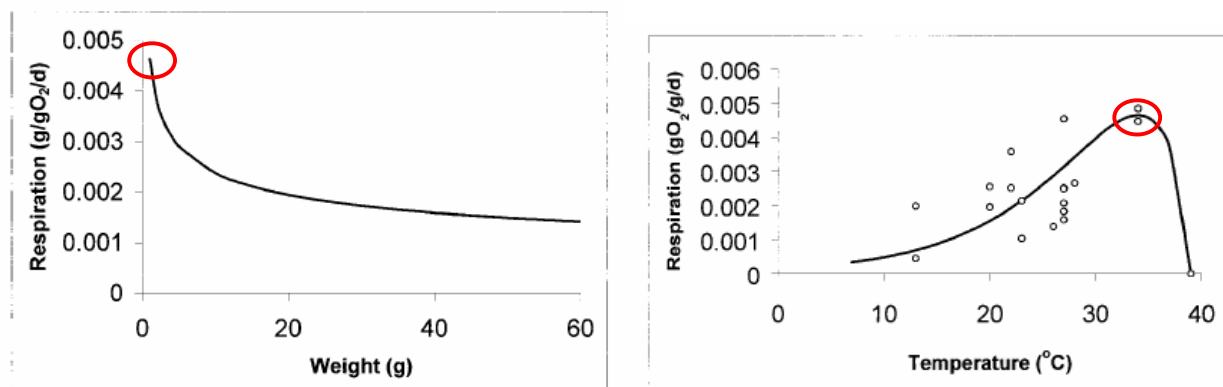


Figure 2. Figures 3 and 4 from Brylawski and Miller suggest that respiration rates shown in Figure 4 are for juvenile 1-g crabs.

Comparison to data taken from adult blue crabs (Booth and McMahon 1992) suggests an intermediate model is more appropriate. This model is also consistent with data from other studies of adult crab metabolism (Batterton and Cameron 1978; Leffler 1972)

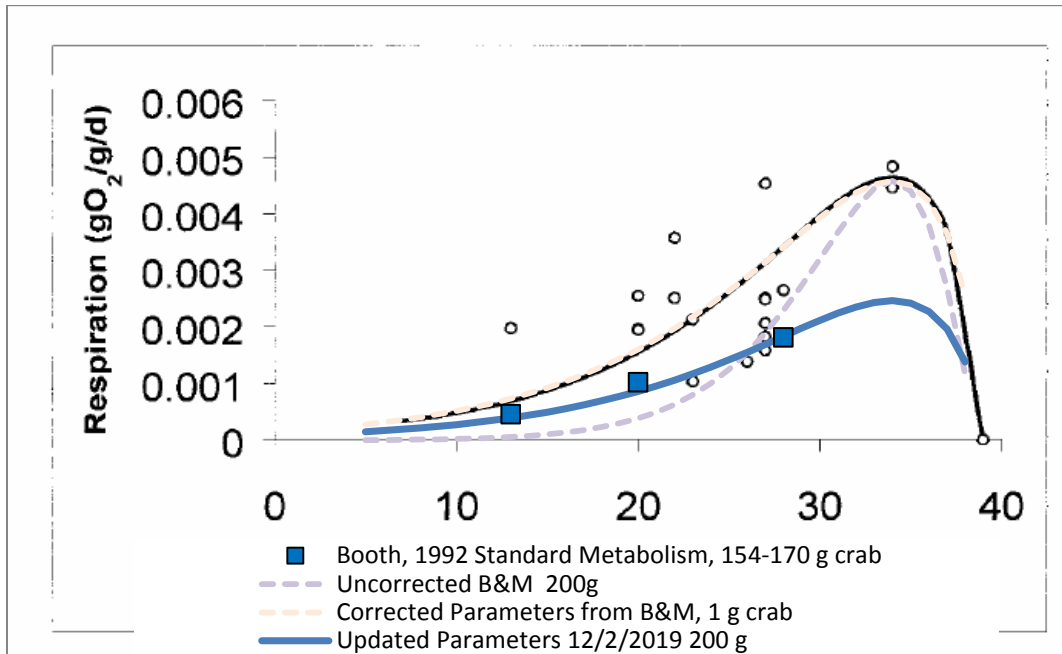


Figure 3. Intermediate adult crab model, blue curve, compared to adult crab data (blue squares) compared with data and models derived from the Brylawski and Miller paper.

The updated curve produces an increase in respiration over the temperature range from 5-25 degrees from the original model produced by CPG. This also increases the amount of food required by blue crab (consumption rate shown in Figure 4).

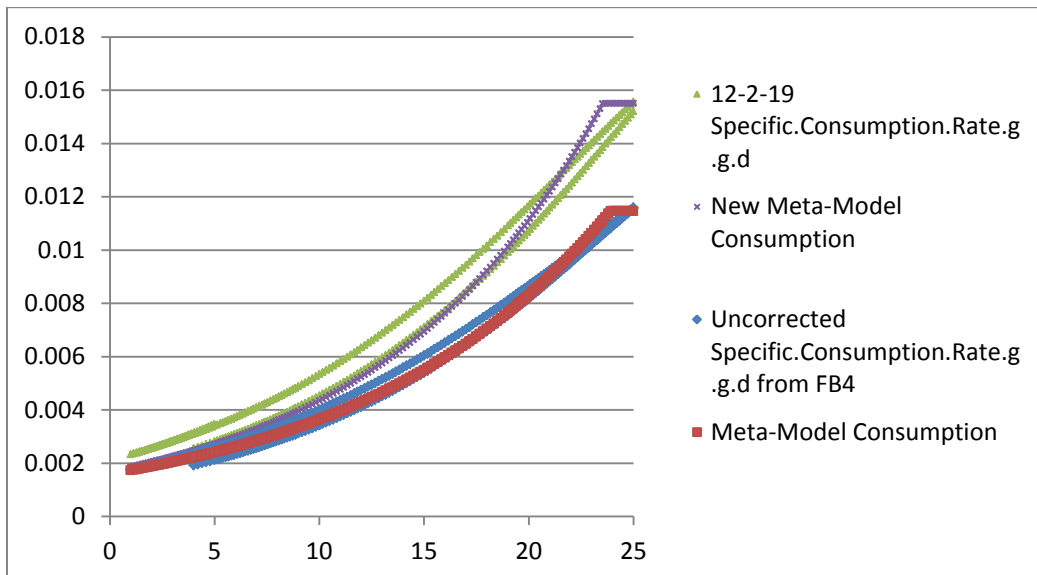


Figure 4. The meta model used within FWM is shown below against the uncorrected FB4 model. A new meta model was derived and is shown above against the corrected FB4 model.

An updated consumption to growth model is also required (Figure 5)

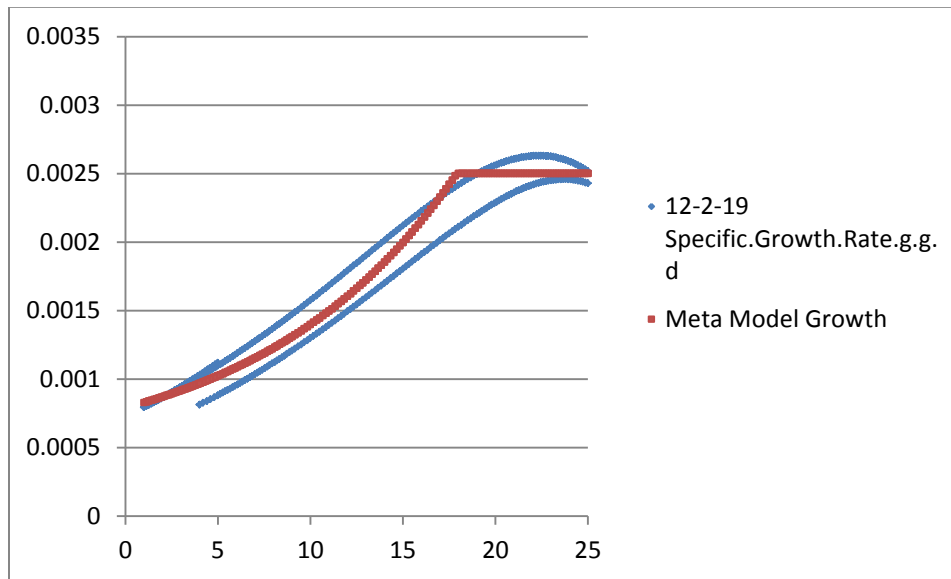


Figure 5. Updated growth rate model using the updated consumption to temperature relationship

A proposed corrected set of parameters for both models looks as follows:

Organism-Specific Parameters	Symbol	Blue crab
Intercept of Temperature vs Specific Consumption Rate relationship ($C = \exp(a + b * T)$)	CvTa	-6.3800
Slope of Temperature vs Specific Consumption Rate relationship ($C = \exp(a + b * T)$)	CvTb	0.0940
Maximum Specific Consumption Rate	Cmax	0.0155
Intercept of Growth Rate vs Specific Consumption Rate relationship ($KG = a + b * C$)	KGvCa	0.0004
Slope of Growth Rate vs Specific Consumption Rate relationship ($KG = a + b * C$)	KGvCb	0.2300
Minimum Growth rate (KG) - leave blank for none	KGmin	
Maximum Growth rate (KG) - leave blank for none	KGmax	0.0025

Having tested several model calibrations against this new parameter set – the result is to increase blue-crab concentrations for all contaminants by approximately 20% (as compared to the original uncorrected parameter set that was published in Brylawski and Miller). While the change affects blue crabs only, it is probably worth correction.

References Cited:

- Batterton, C. V., and Cameron, J. N. (1978). "Characteristics of resting ventilation and response to hypoxia, hypercapnia, and emersion in the blue crab *Callinectes sapidus* (Rathbun)." *Journal of Experimental Zoology*, 203(3), 403–418.
- Booth, C. E., and McMahon, B. R. (1992). "Aerobic capacity of the blue crab, *Callinectes sapidus*." *Physiological zoology*, 65(6), 1074–1091.
- Brylawski, B. J., and Miller, T. J. (2003). "Bioenergetic modeling of the blue crab (*Callinectes sapidus*) using the fish bioenergetics (3.0) computer program." *Bulletin of marine science*, 72(2), 491–504.
- Leffler, C. W. (1972). "Some effects of temperature on the growth and metabolic rate of juvenile blue crabs, *Callinectes sapidus*, in the laboratory." *Marine Biology*, 14(2), 104–110.